AMERICAN TRIASSIC NEOCALAMITES

EDWARD W. BERRY

(WITH PLATE XVII AND ONE FIGURE)

One of the most dogmatic statements of geology and paleontology refers to the almost complete change in the character of the floras in passing from the Paleozoic to the Mesozoic. This is a venerable dogma handed down from generation to generation until it has become almost axiomatic. Nevertheless, like most dogmas both scientific and otherwise, it was originally based upon lack of knowledge and its chief attribute is its unsoundness. A second misconception of a narrower kind is the current belief that the rocks of the Richmond coal-field in Virginia are of Keuper age. This latter seems to be based upon STUR'S comparison (**7**) with the Lunzer Lettenkohl flora of Austria, and upon the somewhat naïve reasoning of SHALER (**6**) that since the continued flora, whose affinities were early recognized, is unmistakably Rhaetic in its facies, it therefore is not of Rhaetic age, since it must have taken it untold years to spread over the world. This is an extreme application of HUXLEY'S principle of homotaxis, which is entirely unwarranted, and one which will be referred to again.

With increasing knowledge it has become obvious that one of the main reasons for the floral break at the close of the Paleozoic is conditioned by the unfavorable character of the early triassic sedimentation for preserving plant fossils. Among the forms which pass the magic boundary are *Glossopteris*, a probable pteridosperm, as WHITE (**9**) and others have pointed out; *Yuccites*, *Noeggerathiopsis*, *Krannera*, *Eolirion*, and *Cardiocarpon*, and possibly other more or less indefinite fossils may represent the Cordaitales in the older Mesozoic, as ZEILLER (**12**) has recently suggested. *Sigillaria* is represented by the form which was christened *Pleuromeia* by CORDA.

A number of genera of cycadophytes are already differentiated in the late Paleozoic, and it has long been evident that, in spite of the contrary tradition, the triassic Equisetales are more like their paleozoic than their existing representatives.

HALLE (3) has recently suggested setting aside certain species formerly referred to the illy understood equisetaceous genus *Schizoneura*, to constitute a separate and perhaps collaterally related genus, for which he has proposed the name *Neocalamites*, and which he compares with the paleozoic *Calamites*. WILLS (11) has supplemented this suggestion by comparing the species which are left in the genus *Schizoneura* with GRAND'-EURY'S *Calamodendron* type of paleozoic *Calamites*, and LIGNIER (5) has recently described *Calamitomyelon Morierei* from the French Lias.

The previously known species of *Neocalamites* are three in number: *N. meriani* (Brongn.), *N. hoerensis* (Schimper), and *N. carrerei* (Zeiller), and all are Keuper or Rhaetic in age. Both this genus and *Schizoneura* have been discussed by WILLS (10, 11) since the appearance of HALLE'S paper, so that further comments are unnecessary.

In an examination of the recently reopened Carbon Hill mine in the Richmond coal-field of Virginia, two equisetaceous types were discovered which are apparently referable to *Neocalamites*. The one, represented by very abundant but exceedingly poor remains, is identified with *Schizoneura virginiensis* described from this area in 1883 by FONTAINE (2). This represents a species which appears to be very close to *Schizoneura meriani* Brongn., and consequently referable to *Neocalamites* as defined by HALLE. It is described by FONTAINE as having several very fine veins, but this character is very obscure in all of the material and may or may not be true. It is something more than a coincidence that a like state of affairs seems to prevail in *S. meriani* described ordinarily as uninerved, but which WILLS has found to sometimes show several fine median veins. The other is an entirely new and remarkable type, which, in its superficial features at least, is very suggestive of the paleozoic *Calamites* with the *Annularia* type of foliage. The two were not found associated, although according to the mine engineer they both came from the same level, that is, the roofing shales of the 6-foot seam. The specimens were collected from the dumps, and their contemporaneous growth should therefore be accepted with caution, since the facies of the plants associated with each is slightly different, but probably equally explicable

either by a slightly different environment or by their having come from a somewhat different level. The dumps from which collections were made represent two openings: the eastermost of which is a slope mine following the dip of the 6-foot seam which comes rather close to the surface near the entrance; the westermost, 200 yards away, known as the Engine Hill mine, is a shaft which was said to strike the same 6-foot seam at a depth of 250 feet, but which was not being worked at the time of the writer's visit. *Neocalamites virginiensis* (Fontaine), as it should be called, was collected from the eastern dump, where it was associated with vast numbers of fronds of *Macrotaeniopteris magnifolia* (Rogers) Schimper, and with the equally abundant stem remains of large and small specimens of *Equisetum* and very rare fern fragments, the whole constituting a typical triassic swamp assemblage.

In the flora associated with the new species of *Neocalamites* the remains of *Equisetum* were almost entirely absent, *Macrotaeniopteris* was not seen, and ferns and cycadophytes greatly predominated. The pinnules of the enormous *Sphenozamites Rogersianus* Fontaine were often packed together in solid masses, among which some nearly complete fronds were collected. *Clathropteris* was common and some of the specimens were remarkably complete. The fern genera identified by FONTAINE as *Acrostichides*, *Mertensides*, etc., were abundant, and various *Ctenis*-like and *Pterophyllum* forms were collected. Sparingly represented were those curious forms described by EMMONS (**1**) over 50 years ago from the North Carolina Triassic area under the name *Lepacyclotes*.

EMMONS (**1**) described two species in 1856 as *Lepacyclotes ellipticus* and *L. circularis*. These were discussed by FONTAINE (**2**) in 1883 in his monograph of the Virginia Triassic. At that time he considered them as probably representing a single species of crushed cone closely allied to *Araucaria*, and they were renamed by him *Araucarites carolinensis*. In returning to the same subject in 1900, after the rediscovery of the EMMONS' collection, he abandons this view and returns to EMMONS' names, his final opinion being that the disklike forms represent *Equisetum* diaphragms, and the scalelike forms fragments of *Equisetum* stems (**8**). I am not in a position to discuss the first assumption, since I have not seen the

material. The second is clearly erroneous. The Virginia specimens are cone scales, and while it is merely a supposition, I would be inclined to consider them as representing contemporaneous cycadophytes rather than Araucarieae.

The new species of *Neocalamites* was collected by the writer and T. E. WILLARD of the U.S. National Museum, and is named in honor of Dr. F. H. KNOWLTON, who was instrumental in bringing about the writer's visit to the mine.

Neocalamites Knowltoni, sp. nov.

The main axis is preserved for a distance of 14 cm., and shows 8 nodes in this interval. It is slender, being 8 mm. across the flattened proximal end, and 6 mm. across the flattened distal end. The nodes are about 2 mm. apart, and show no traces of leaves or sheaths. The surface is lined longitudinally, and there is no apparent alternation of vascular strands at the nodes, a variable feature in this whole class of plants and much less important than was formerly supposed to be the case. Leaf-bearing branches opposite. They were possibly in whorls in some cases, since there appear to be 1 or 2 branch scars just above certain of the nodes, which, if they indicate fully developed branches in addition to the two opposite ones which are preserved, would make the leaf-bearing branches 3 or 4 in number at these respective nodes. It is believed, however, that the functional branches were usually but 2 in number and opposite, since no traces of additional branches are preserved. If other branches developed occasionally, they may be regarded as reversions to an ancestral verticillate arrangement, and the branch scars above mentioned may be interpreted as the scars of such aborted or non-persistent branches.

Lateral foliage-bearing branches preserved for a length up to 7 cm., slender, being not over 3 mm. across at the proximal end after flattening due to the compression of fossilization. Internodes short, about 1 cm. in length, longitudinally striated.

Leaves in whorls of 9 or 10 at the nodes of the lateral branches, apparently free, although they may be slightly united at the base as in the paleozoic Annularias, the material collected being not entirely conclusive on this point. They are linear-lanceolate in

outline, with an obtusely pointed apex, about 1 cm. in length by 1.5 mm. in greatest width. All the leaves in a whorl are of approximately the same size.

From their position as fossilized, they seem to have been superimposed from node to node, and each verticil seems to have been in a plane very oblique to the supporting axis and not at right angles to it, so that the foliage-bearing branch with its unit whorls is, as a whole, bifacial.

Leaf substance thick and coriaceous. Within the limits of the specimen there is scarcely any diminution in the size of the leaves or length of the internodes distad from the main axis, although the branch itself tapers slightly.

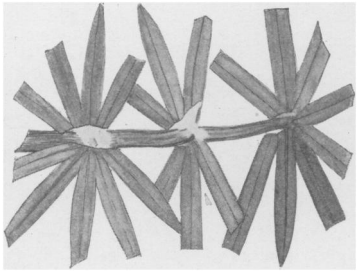

FIG. 1

The venation is puzzling because of the thick nature of the leaves and their indifferent preservation, some leaves apparently showing a thick prominent midrib, while in others its place was apparently occupied by what seem to be several very fine vascular strands.

The writer's final conclusion is that each leaf has a single midrib, which was broad, but immersed in the leaf substance and not at all prominent in life. This midrib may have been made up of several vascular strands, and varying conditions of preservation account for the deceptive appearances in some of the leaves.

The accompanying text figure (fig. 1) is from a drawing ($\times 4$) which shows three verticils, and is drawn from a counterpart of the type which is shown natural size on pl. XVII.

In the absence of any very complete knowledge of the older mesozoic Equisetales, the affinities of the present species are more or less conjectural. It fulfils all of the requirements of HALLE's definition of the genus *Neocalamites*, and the genus itself seems to be a natural one. It is more like *Calamites*, however, than the species which HALLE has referred to the genus, and suggests most strongly the *Annularia* type of paleozoic calamite foliage, as, for example, the widespread type known as *Annularia sphenophylloides*, the only difference being that in the triassic *Neocalamites* the leaves

of a whorl are not dissimilar in size. A second possible difference is that the leaves appear free to the base. This is not positively ascertained, however, and is of slight importance at best, since there must have been a progressive change from free leaves to united sheaths and vice versa, when the group as a whole is considered, and the two lines of variation may have been contemporaneous within the phylum.

There is also a suggestive resemblance between the present species and the forms from the homotaxial Rhaetic deposits of Tonkin described by ZEILLER (**13**, p. 132. *pl. 35. figs. 2–7*) as *Annulariopsis inopinata*, gen. et sp. nov. This remarkable form, while based upon rather incomplete material, shows whorls of 16–24 lanceolate-spatulate, uninerved, free leaves, the main difference betwen it and *Neocalamites Knowltoni* being the uniform size of the leaves of the latter. In *Annulariopsis* each whorl shows short leaves on one side and long leaves on the opposite side, with a regular gradation between the two, the maximum being 100 per cent larger than the minimum.

It appears, therefore, that as regards habit and superficial characters *Neocalamites* was closely allied to and undoubtedly descended from some paleozoic *Calamite*. On the other hand, it does not seem to be genetically related to *Schizoneura*, although it comes after it in time.

Neocalamites Knowltoni was a large plant, and it is quite possible that some of the fragments of large stems 10 or 12 cm. in diameter, which are so abundant at some horizons in the coal-field, may represent the main axis. The axis of the specimen, with its leaf-bearing subordinate branches, is interpreted as a lateral branch which was distinctly bifacial in habit. The material from the Triassic is too limited for certainty on this point, but it seems difficult to account for the uniform orientation of the numerous whorls of leaves on the distichous branches by appealing to compression during fossilization, which it would seem reasonable to suppose on even a single specimen would flatten some leaves in one direction and some in another and would break off or bend some of the leaves.

The obliquity of the plane of the verticils in *Annularia* is often insisted upon in the diagnosis of this paleozoic type, although some

authors explain this feature by compression during fossilization. In this case also the mechanical orientation of the *Annularia* whorls in the thousands of specimens which have been collected is difficult if not impossible of adequate explanation if the theory that the leaves in life radiated at right angles to the axis be adopted. The present specimen comes from the immediate vicinity of the old Carbon Hill mine, about one mile south of Gayton on Tuckahoe Creek, near the western border of Henrico County, Virginia, from beds of undoubted Rhaetic age, and the type is deposited in the U.S. National Museum, duplicate and less perfect material being retained in the collections of the Johns Hopkins University.

JOHNS HOPKINS UNIVERSITY
BALTIMORE, MD.

LITERATURE CITED

1. EMMONS, E., Geol. rept. of the midland counties of North Carolina. Raleigh. 1856.
2. FONTAINE, W. M., Contribution to the knowledge of the older mesozoic flora of Virginia. Monograph U.S. Geol. Surv. **6**:1883.
3. HALLE, T. G., Zur Kenntnis der mesozoischen Equisetales Schwedens. Kgl. Svenska Vetens.-Akad. Handl. **43**:pp. 56. *pls. 9.* 1908.
4. KRASSER, F., Zur Kenntnis der fossilen Flora der Lunzer Schichten. Jahrb. Geol. Reichs. **59**:101–126. 1909.
5. LIGNIER, O., *Calamitomyelon Morierei*, gen. et sp. nov. Bull. Soc. Linn. Normandie VI. **2**:116–128. *pls. 1–3.* 1908.
6. SHALER, N. S., and WOODWORTH, J. B., Geology of the Richmond Basin, Virginia. 19th Ann. Rept. U.S. Geol. Surv. II. 1899: 385–520.
7. STUR, D., Die Lunzer (Lettenkohlen) Flora in den "Older mesozoic beds of the coal-field of eastern Virginia." Verh. Geol. Reichs. Wien. 1888: no. 10. 203–217.
8. WARD, L. F., with the collaboration of FONTAINE, W. M., WANNER, ATREUS, and KNOWLTON, F. H., Status of the mesozoic floras of the United States. First paper: The older mesozoic. 20th Ann. Rept. U.S. Geol. Surv. II. 1900:211–748. *pls. 21–179.*
9. WHITE, DAVID, Fossil flora of the coal measures of Brazil. III. Rept. Brazilian Coal Commission 1908:337–617.
10. WILLS, L. J., The fossiliferous lower Keuper rocks of Worcestershire. Proc. Geol. Ass. **21**:271–287. 1910.
11. WILLS, L. J., Notes on the genus *Schizoneura* Schimper and Mougeot. Proc. Cambridge Phil. Soc. **15**:406–410. 1910.
12. ZEILLER, RENÉ, Les progrès de la paléobotanique de l'ère des gymnospermes. Progressus Rei Botanicae **2**:171–226. 1907.
13. ZEILLER, R., Fl. foss. des gites de charbon du Tonkin. Paris. 1903.

Neocalamites Knowltoni Berry